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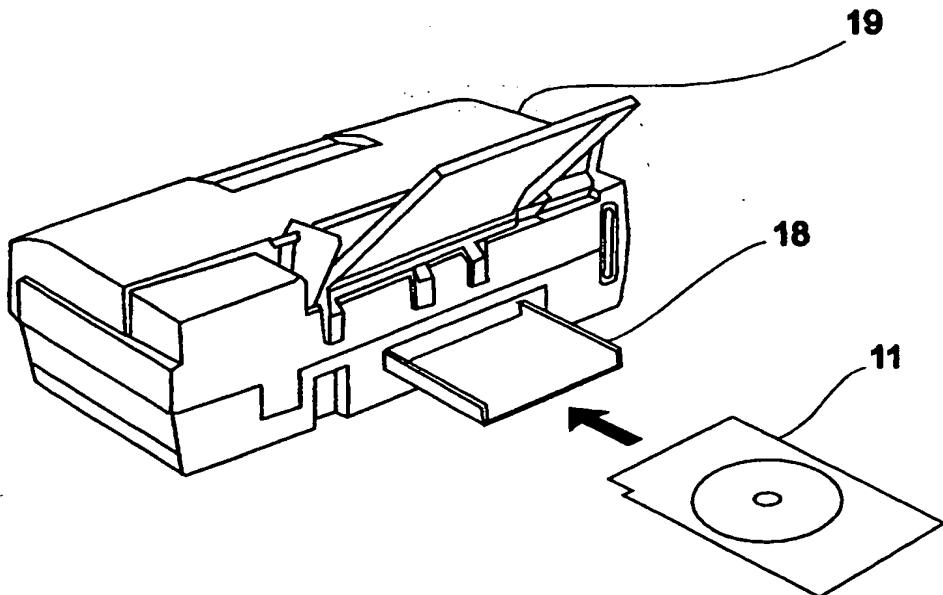
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: INKJET PRINTER FOR PRINTING COMPACT DISKS



(57) Abstract

A system (19) for inkjet printing of CDs comprises loading the CD into a rigid carrier (11) with a cavity which holds a CD flush with the upper surface of the carrier, passing the carrier past the inkjet printing head and printing the CD, and emptying the carrier. Loading and emptying may be automated. The carrier may have doors for releasing the printed CD in an automated system. A printer designed for printing paper may be adapted to operate the system while still being capable of printing paper.

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## INKJET PRINTER FOR PRINTING COMPACT DISKS

The invention relates to inkjet printers.

Inkjet printers have conventionally been used for a variety of applications, from printing labels, articles and packaging directly, to printing standard paper stock.

The present invention provides dual purpose inkjet printer which are suitable for printing both standard paper stock and direct printing compact disks ("CD"), and further provides a method and apparatus for printing CDs.

Compact disks have generally been labelled by using expensive printing processes, such as by screen printing, or by printing labels and adhering them to the CD. The former is unsuitable for domestic use or for small scale production of CDs. The latter is unsatisfactory because the labels must be precisely aligned in high speed drives to avoid unsuitable vibrations, and because the labels may become partly detached or buckled and interfere with the drive machinery.

The present invention provides a method of printing CDs in an inkjet printer, comprising loading the CD into a feed carrier comprising a substantially rigid holder having a substantially planar (upper) surface, the surface having a cavity adapted to receive a CD so that the (upper) surface of the CD lies substantially flush with the upper surface of the feed carrier, mechanically feeding the feed carrier (with the loaded CD) past the print head, and printing on the CD, and thereafter emptying the CD from the feed carrier.

In this context the term CD is intended to include other similar subject matter and in particular other type of similar recording medium such as DVD disks.

Preferably after such printing the printed CD is lacquered in order to protect the printed surface.

Preferably the carrier is in a form in which it can be used with standard inkjet printer engines, in particular such engines which are for use in printing sheet paper stock, with little or no adaptation. For example inkjet printers for printing on standard sheet paper stock are widely available and thus the engines are both well developed and reliable and are available at a very low cost. One aspect of this invention is to provide a method of printing CDs which can use such engines, comprising the print head and associated paper feed rollers and preferably the associated control electronics with no or little adaptation.

Conveniently the feed carrier is in the form of a planar sheet, for example a comparatively thin planar sheet which is sufficiently rigid that it does not distort out of its planar configuration during the printing process. The carrier is designed such that the CD is held with its upper surface substantially flush with the upper surface of the carrier, and is supported so that it is not susceptible to any significant movement within the carrier. Generally a suitable carrier can be based on a carrier which has a circular recess which is complementary in shape to a conventional CD, and permits the CD to fit snugly into, and flush with, the surface of the carrier. Preferably the carrier also has additional means for restricting movement of the CD, such as by suitable surface treatment, by rubber supports or by additional clips or fasteners. Such additional means should not protrude substantially above the upper surface of the carrier. Preferably such a carrier, together with its contained CD, can be passed through a standard print engine for paper stock, between the existing printer rollers, on only a slightly adapted roller arrangement. Clearly this applies only to those rollers within the print engine which are in a substantially in-line arrangement.

It has been found that, in view of the very high degree of precision required in printing high quality prints on CDs and the very small amount of movement which can affect the consistent quality of such printing, that some means are required to additional "fixing" of the CD in addition to the snug fit recess.

The central area of the recess is conveniently removed, so that the CD is supported on a rim around the edge of the recess. For example, a circular hole may be provided through the planar

carrier. This facilitates removal of the CD from the recess, because it permits the user or equipment to press upwards in order to release the CD.

The carrier is generally substantially rectangular in plan view.

The carrier in accordance with the present invention must be substantially rigid in the region of the disk. Preferably it has a rigidity in both directions (lying in the plane corresponding to the plane of the CD). Conveniently the carriers have been made from anodised aluminium alloy, for example 6082-T6 hard aluminium. Preferably however a plastics material is used because it can, advantageously be mass produced more economically. When plastics material is used it may be desirable to add further rigidity by adding longitudinal ribs at the underside of the carrier, in a position which is complementary to slots or recesses in the paper support members of the printer. In this way greater rigidity can be introduced without adversely affecting the printer performance with paper.

The carrier may be provided with ejection means, which allows automatic ejection of the CD from the carrier or means for facilitating the emptying of the carrier. Preferably the carrier recess in such a case is in the form of a simple disc shaped cutout from the carrier and clamping means are provided substantially within the thickness of the carrier for holding the CD in place. Such clamping means may be in the form of cams abutting the recess, so that on activation the cams rotate and part of the cam surface presses inwardly into the recesses. Such cams may conveniently be spring loaded in a "secure" position.

In a further aspect of the invention the feed carrier comprises a substantially rigid holder having a substantially planar (upper) surface, the surface having a cavity adapted to receive a CD so that the (upper) surface of the CD lies substantially flush with the upper surface of the feed carrier, the cavity being in the form of a bore which passes through the holder. Preferably the bore is closed off at a suitable position, conveniently its lower end, by doors which can be opened to permit ejection of the CD or emptying of the CD out of the carrier. The doors can form the whole or, preferably, part of the lower surface of the cavity, for example they can form flanges

around the lower periphery of the cavity. Preferably such a carrier is in the form of a generally planar sheet.

Where the feed carrier is in the form of a generally planar sheet, it has been found that doors comprising thin planar, shaped elements can conveniently be hingedly secured, to the bottom surface of the planar sheet, so that they partially cover the bottom of the cavity. Conveniently the doors are hinged about an axis perpendicular to the plane of the planar sheet, and at some distance external to the edge of the cavity. On rotation about the hinge point, the planar elements can be moved so as to cover the bottom of the cavity partially, and alternatively, so as to leave the bottom of the cavity entirely clear. The planar elements may be secured to the lower surface of the planar sheet, in which case preferably the other free areas of the lower surface of the sheet are also covered by a sheet material to approximately the same depth as the planar elements. (By free areas are meant areas which are not covered by the planar door elements in the positions which those elements may be desired to occupy). Alternative the planar sheet from which the feed carrier is formed may be machined or otherwise provided with a recess to accommodate the planar door elements so that the door elements are, at least when closed, substantially accommodated within the thickness of the sheet.

According to the invention an inkjet printer suitable for printing conventional paper stock is adapted to be suitable for printing CDs as well as conventional paper stock. This can be carried out without any requirement to make any physical adjustments to the printer when changing between a CD and paper. Accordingly a dual purpose printer is provided which prints conventional paper stock and is adapted to operate in accordance with the method described above. In the system according to the invention the CD is held in a carrier.

The printer includes a carrier feed station and a carrier feed path. The carrier feed path comprises a straight through path which passes between the feed rollers of the printer and in close proximity to the print head inkjet surface. The path is made by cutting a slot or opening sufficient to permit the carrier to enter into the existing paper path, such that the carrier can be fed in a straight line from the carrier feed station through the print location and out of the printer whilst maintaining

an orientation suitable for printing. By print location is meant the location of the substrate under the print head for printing to take place.

In addition it has been found necessary in some cases to alter the paper guides in conventional printing apparatus to ensure that a path is provided for the carrier such that, while printing, it is not moved materially out of its own plane. For example, printers may have plastic supports on the paper guides to induce a small amount of additional curvature in the paper as it comes off the roller. It has been found that removing the substantial part of such supports in the central region through which the carrier is diverted does not adversely affect the printing performance of the printer on standard paper stock, to any material degree, whilst improving the performance in printing CDs very substantially.

The print feed station comprises a platform adapted to be fixed to the printer at a position aligned with the inlet to the CD feed path. The platform is adapted to support carriers in position prior to feeding, and accordingly has a plane aligned with the straight through print path. It has flanges forming walls on each side of the feed path, so as to ensure that carriers are properly aligned as they enter the feed path. Conveniently the platform is made from metal or plastic. At the front edge of the platform a slot or aperture is provided, through which the carrier can pass into the standard paper path, adjusted as referred to above.

In adapting printers according to the invention it may be necessary to ensure that the paper feed switch is also activated by the CD carrier.

Another variation of the invention provides that the feed switch detect the presence or absence of a CD in the carrier in order to prevent accidental printing onto an empty carrier.

In a further variation of the invention, the feed carrier is passed only part way through the printer, and the CD is ejected or removed and the printer feed is then reversed to restore the carrier to the feed station. According to a further aspect of the invention there is provided a method of printing CDs automatically, comprising:

- a) mechanically loading a CD into a feed carrier, the feed carrier comprising a holder having a substantially planar (upper) surface in which there is a cavity adapted to receive a CD so that the (upper) surface of the CD lies substantially planar with the upper surface of the feed carrier;
- b) mechanically moving the carrier, with the held CD, past an inkjet print head of an inkjet printer, and printing on the CD via the inkjet print head;
- c) to an emptying position, and mechanically emptying the CD from the feed carrier;
- d) and repeating the steps a) to c) for further CDs.

The feed carrier may be cycled from a loading station at which loading takes place, past the print location, to an emptying station, and then back to the loading station. Alternatively, the loading station and the emptying station may be at the same physical location, in which case the feed carrier is cycled from that location past the print head, and back (while still holding the CD) to the same location, where it is emptied, for example by opening the doors under the cavity or by ejecting the CD upwards out of the feed carrier, and thereafter the next CD is loaded (after closing the doors if they are present). The cycle is then repeated.

Preferably such a method uses a “paper stock” print engine, comprising print head (including associated movement mechanisms) and feed rollers preferably together with controlling circuitry, without any adaptation, or with minimal adaptation for handling the feed carrier. By “paper stock” print engine is meant one which is generally produced for use in printers of standard sheet paper stock.

The following figures illustrate the feed carrier and a printer in accordance with the present invention.

Figure 1 is a planar view of a simple feed carrier.

Figure 2 is a cross section of the feed carrier of Figure 1.

Figure 3 is a perspective view of a printer adapted for use with the feed carrier of Figure 1.

Figures 4 and 5 are plan views of a modified feed carrier for use in the automated printing method.

Figure 6 is a cross section of the feed carrier of Figures 4 and 5, with the doors shown in the closed position as in Figure 4.

The figures are not drawn to scale.

In this example the carrier (1) is in the form of a rigid substantially rectangular plate of width 140 mm, length 240 mm, and thickness 1.6 mm. A recess (2) has been cut 1.2 (+/-0.1) mm deep in a shape complementary to that of a CD, leaving a recess 120 mm in diameter and 1.2 mm deep with a flange (3) 15mm in width to support the CD in position. Securing tabs (not shown) are provided to prevent unwanted movement of the disk in the recess, particularly in the event it is of a slightly non-standard size. The bottom of the recess is cut away to leave an opening (4), which permits easy access to the CD for removal. The upper surface (5) of the feed carrier (1) is substantially planar and the feed carrier adapted such that the CD's upper surface is substantially flush with the upper surface (5). (In this context the terms upper and lower or bottom are intended to be relative terms for convenience in understanding the areas referred to and are not intended to denote the orientation in space of the article).

In Figure 3, a printer is shown in a form adapted to operate in the method of the invention. The feed station (18) is mounted on the rear of the printer (19), and is aligned so that it supports a carrier (11) so that the plane of the carrier lies in the plane of the feed path and print location.

At the feed exit path the plastics paper support bar carries paper supports in the form of upstanding pillars. In the central region, the height of these pillars has been reduced to assure the carrier of undisturbed through path.

Figures 4 and 5 show a feed carrier (21) provided with planar sheet doors (26, 26) pivoted about an axis (27, 27) perpendicular to the plane of the sheet and external to the cavity (22). In this case the doors (26) are shaped so that they substantially correspond to the shape of the flanges (3, Figure 1) in the earlier described carrier. Preferably the internal shaping of the doors (26) is such that the internal radius (28) corresponds to the radius of the cavity (22). In this way all elements of the door can be made to clear the edge of the cavity simultaneously. The depth of the cavity (22) also corresponds substantially to the depth of the cavity in the earlier described feed carriers (ie between the upper surface of the flanges (3, Figure 1) and the surface (5, Figure 1) of the carrier). This is necessary to ensure that the upper surface of the CD is substantially flush with the surface (5, in Figure 1) of the feed carrier. Usually carriers of Figure 4, 5 are used in single purpose printing machines which are adapted for use for printing CDs in bulk.

The description illustrates particular ways in which the invention can be implemented. The reader will appreciate that inventive features can be extended in a number of ways.

## CLAIMS:

1. A method of printing CDs in an inkjet printer having an inkjet print head, comprising loading a CD into a feed carrier comprising a substantially rigid holder having a substantially planar (upper) surface, the surface having a cavity adapted to receive a CD so that the (upper) surface of the CD lies substantially flush with the upper surface of the feed carrier, mechanically feeding the feed carrier (with the loaded CD) past the print head, and printing on the CD, and thereafter emptying the CD from the feed carrier.
2. A method according to claim 1 in which the feed carrier in which the cavity is in the form of a bore which passes through the holder.
3. A method according to claim 2 in which the bore of the carrier is closed off at a suitable position, for example its lower end, by doors which can be opened to permit ejection of the CD or emptying of the CD out of the carrier.
4. A method according to claim 3 in which the feed carrier is in the form of a generally planar sheet, and the doors comprise thin planar, shaped elements hingedly secured to the bottom surface of the planar sheet, so that in the closed position they at least partially cover the bottom of the cavity.
5. A method according to claim 4, in which the doors are hinged about an axis perpendicular to the plane of the planar sheet.
6. A dual purpose inkjet printer which prints conventional paper stock and is adapted to operate in accordance with the method according to any of the preceding claims.
7. A method of automatic printing CDs comprising:

- a) mechanically loading a CD into a feed carrier, the feed carrier comprising a holder having a substantially planar (upper) surface in which there is a cavity adapted to receive a CD so that the (upper) surface of the CD lies substantially planar with the upper surface of the feed carrier;
- b) mechanically moving the carrier, with the held CD, past an inkjet print head of an inkjet printer, and printing on the CD via the inkjet print head;
- c) to an emptying position, and mechanically emptying the CD from the feed carrier;
- d) and repeating the steps a) to c) for further CDs.

8. A method according to claim 8, in which the feed carrier is as defined in any of claims 1 to 5.

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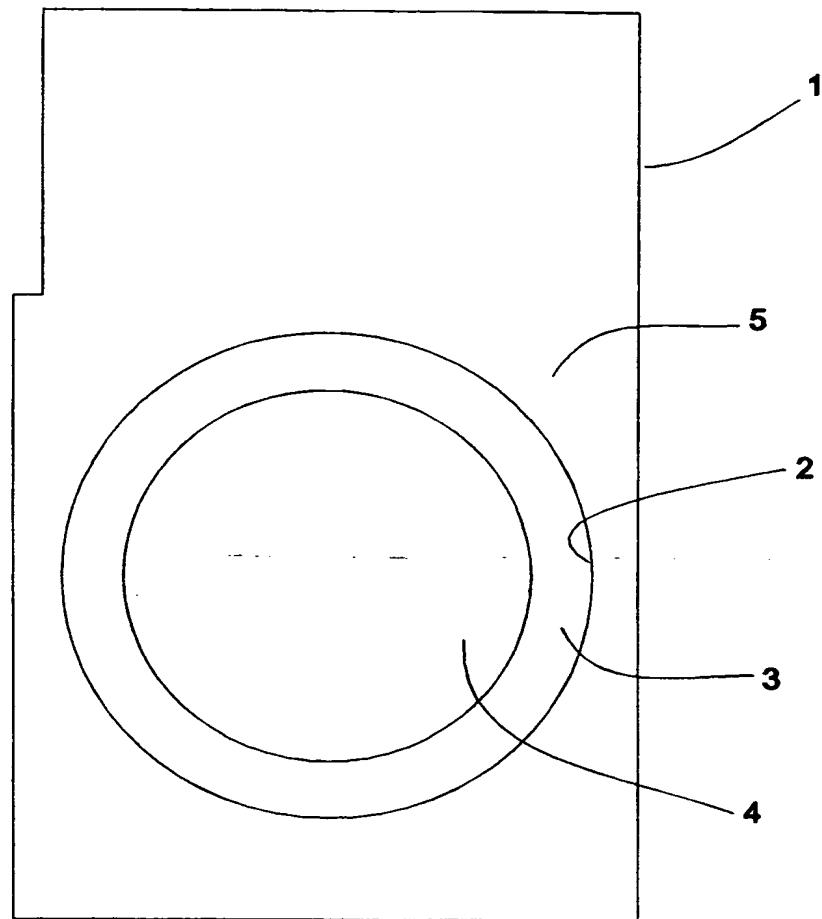


Figure 1

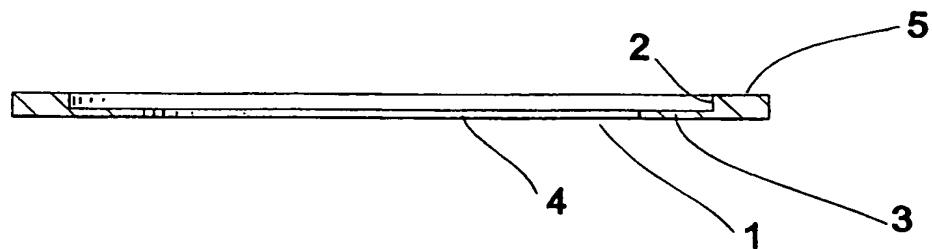
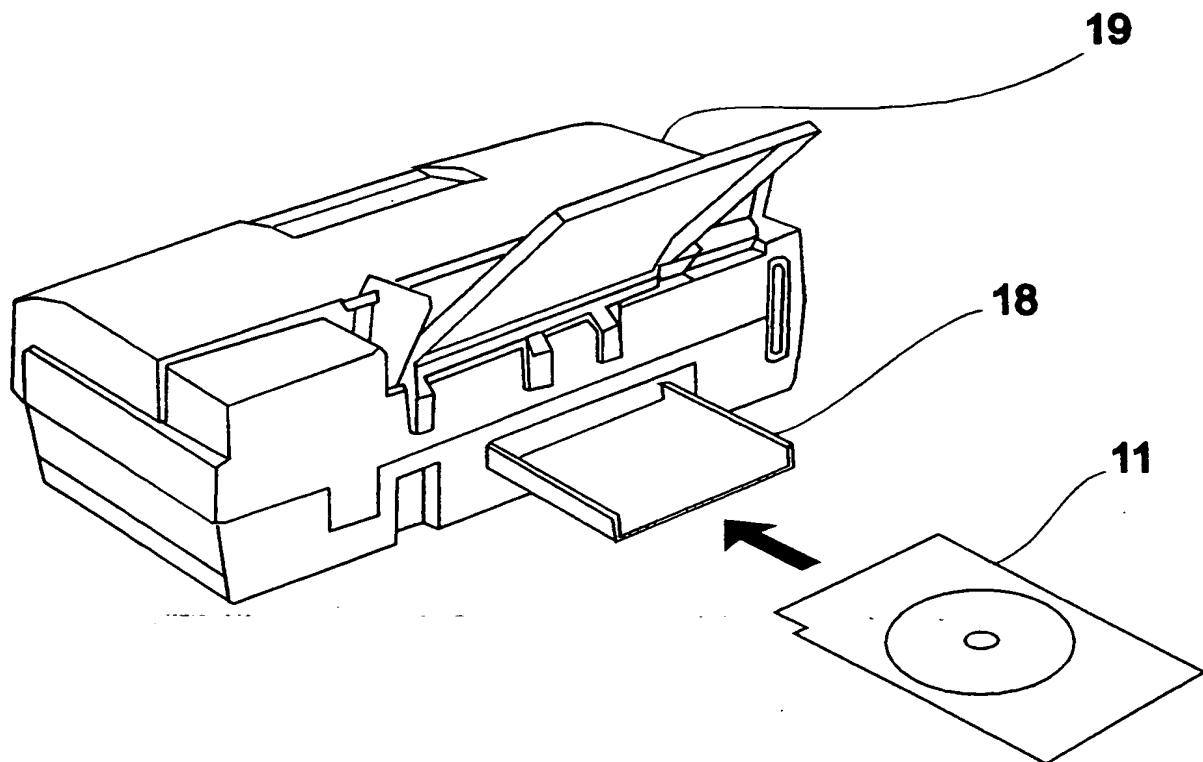


Figure 2

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**Figure 3**

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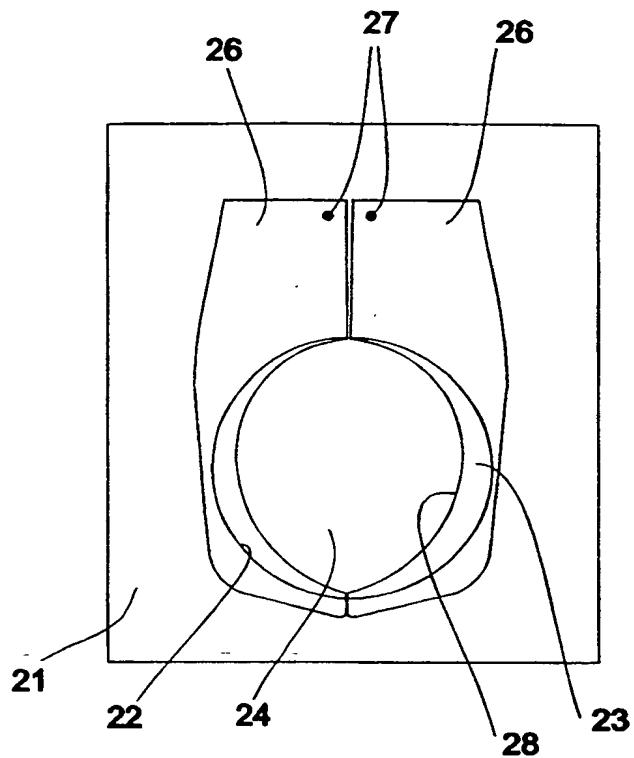


Figure 4

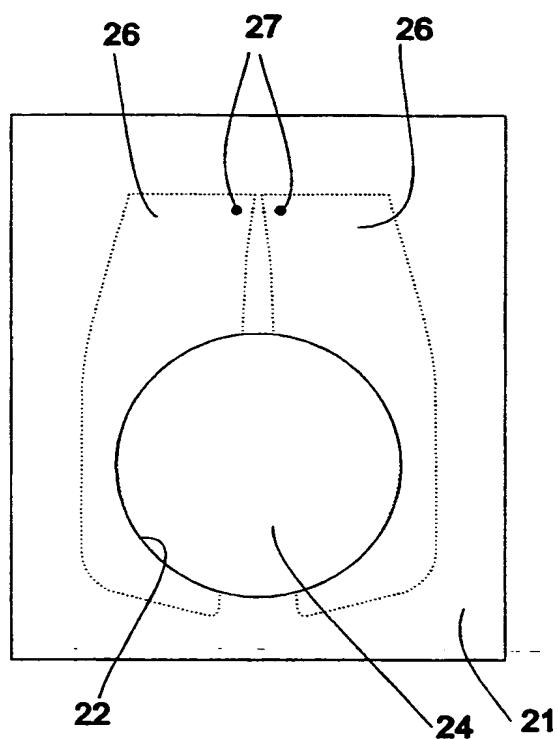


Figure 5

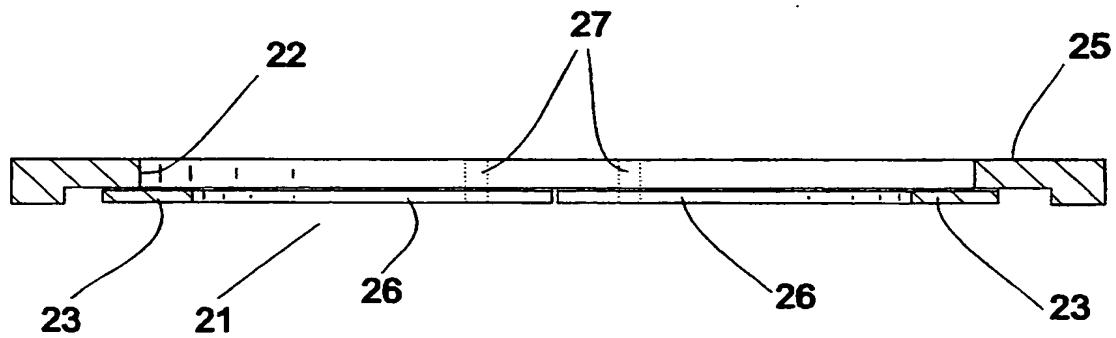


Figure 6

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# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 99/01151

## A. CLASSIFICATION OF SUBJECT MATTER

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	EP 0 799 710 A (MASTERMIND CO LTD) 8 October 1997 (1997-10-08) column 4, line 49 - column 6, line 40; figures 1,,2A,2C	1,2,6-8
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Date of the actual completion of the international search

14 July 1999

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# INTERNATIONAL SEARCH REPORT

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**C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 097, no. 012, 25 December 1997 (1997-12-25) & JP 09 201958 A (CANON INC), 5 August 1997 (1997-08-05) abstract ---	1,6-8
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